METHOD AND DEVICE FOR CONTROLLING A DRIVE UNIT OF A VEHICLE

Field Of The Invention

The present invention relates to a method and a device for
controlling a drive unit of a vehicle.

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Background Information

A method and a device for controlling a drive unit of a
vehicle are described in German Patent No. 195 34 633, for
10 example. In the method and device described therein, changes
in engine torque are delayed by low-pass filtering of the
driver's selection. In addition, a pulse-shaped characteristic
of the injection volume is proposed to achieve a smooth
application of the engine, after which the amount of fuel
15 injected is released for acceleration without delay.

Low-pass filtering has a negative effect on the spontaneity of
the driving performance. In addition, with modern drive train
concepts, an interaction between engine movement and drive
20 train may be observed, so that load shock may be further
intensified.

Summary Of The Invention

25 Changes of state between thrust and traction may be
implemented very rapidly due to the fact that a filter in
which at least one high-pass filter and one low-pass filter
are connected in parallel is used. Due to the rapid change of
state, a spontaneous response of the vehicle to the driver's
30 selection may be implemented. Damping of shock on arrival in
the new contact position yields a definite noise reduction

during the load reversal process, a reduction in the load
shock at load reversal as a result of minor changes in the
driver's selection and a reduced bucking tendency of the drive
train.

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Due to the parallel connection of the signals of the high- and
low-pass filters and the fact that the variation of their
phase angles is applied to the engine-drive train combination,
the driving performance may be designed to be largely
10   independent of the damping of load shock.

When there are gradual changes in driver's selection, a
comfortable transition in state is possible even without
acceleration and deceleration of masses. With such an
15   excitation, there is no intervention by the load shock damper.

Due to the special combination of filters, the masses of the
drive train are accelerated by at least one moment pulse and
are decelerated again prior to reading the new contact
20   position, so the position of this pulse relative to the time
of the change in quantity selection as well as the position of
the pulses relative to one another are variable.

Brief Description of the Drawings

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Figure 1 shows a block diagram of a device for controlling a
drive unit of a vehicle according to the present invention.

Figure 2 shows a detailed illustration in the form of a block
30   diagram of the device for controlling a drive unit of a
vehicle according to the present invention.

Figure 3 shows filtered signals plotted over time.

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<u>Detailed Description</u>

Figure 1 shows a block diagram of a device for controlling the
drive unit of a vehicle in which the procedure according to
the present invention may be used. The procedure according to
the present invention is illustrated here with the example of
a diesel engine. However, the procedure according to the
present invention may also be used with other types of
internal combustion engines, in particular engines having
spark ignition.

The figure shows an internal combustion engine 100 connected
to a controller 110. Controller 110 processes signals of
various sensors 115 and a signal QKF supplied by a filter
means 120. Filter means 120 receives signal QK as an input
quantity. The filter means also processes the output signals
of various sensors 125. Signal QK is supplied by a quantity
input 130. The quantity input receives signals from a
accelerator pedal position sensor 140 and various sensors 135.

Starting from the position of the accelerator pedal, the
accelerator pedal position sensor 140 generates a signal FP
with regard to the position of the accelerator pedal. The
accelerator pedal position sensor may be designed as a rotary
potentiometer, for example. A resistance value and/or the
voltage drop on the potentiometer is used as the signal in
this case.

Starting from the output signal of accelerator pedal position
sensor 140 and the output signals of various sensors 135,
quantity setpoint 130 calculates signal QK, which is a measure
of the power desired from the engine. Fuel quantity QK is
selected, for example, according to sensors 135, which detect
various temperature values, pressure values and other
operating states.

In the case of a diesel engine, this is may be the quantity of

fuel to be injected. In the case of an engine having spark ignition, this is may be a signal indicating the throttle valve position or the ignition time.

5   To prevent load shock, the injection quantity must not be released suddenly in the case of a diesel engine. It is sufficient here to filter the injection quantity only in the range in which the engine is moving relative to the vehicle body. This filtering of the fuel quantity signal takes place

10   through filter means 120, with the filtering depending on various status parameters characterizing the state of the combustion engine and/or the vehicle driven. Filtering can depend on rpm, which is detected by an rpm sensor 125. The transmission performance of filter means 120 is shown in

15   Figure 2. Filtered quantity signal QKF is sent to controller 110.

Actuator 110 is, for example, a fuel metering device which sets the quantity of fuel to be injected. It may be, for example, a solenoid valve. Depending on filtered fuel quantity

20   signal QKF and the output signals of other sensors 115, controller 110 apportions the proper amount of fuel to combustion engine 100.

25   The procedure according to the present invention is not limited to use with diesel engines. It may also be used with other internal combustion engines. Furthermore, it is not limited to use with fuel injection. It may also be used with other quantities that determine power delivery, such as the

30   throttle valve setting or the firing angle.

Figure 2 shows filter means 120 in detail. Elements already described in conjunction with Figure 2 are labeled here with the same reference numbers. Quantity request signal QK goes to

35   a first lag element 200, a second lag element 220 and a third lag element 250. A low-pass filter 210 receives the output signal of first lag element 200. Signal QKF0 is available at

the output of low-pass filter 210 and acts on a first coupling point 215.

The output signal of second lag element 220 goes via a first input limiter 230 to a first high-pass filter 240. Output signal QKF1 is available at the output of the first high-pass filter and is sent to first coupling point 215.

The output signal of third lag element 250 goes over a second input limit 260 to a second high-pass filter 270. The output signal of second high-pass filter 270 goes to a second coupling point 280 at whose second input the output signal of first coupling point 215 is available. The output signal of coupling point 280 goes to actuator 110 as filtered quantity request QKF via an output limiter 290.

A PTD1 element may be used as low-pass filter 210. However, other filters having low-pass characteristics may also be used according to the present invention. Filters having a DT1 characteristic may be used as the first and second high-pass filters. However, other filters having high-pass performance characteristics may also be used.

In a simplified embodiment, third lag element 250, second input limiter 260 and/or second high-pass filter 270 may be omitted. The arrangement of lag elements 200, 220 and 250 is selected only as an example. These lag elements may also be arranged downstream from the input limit or downstream from the low- or high-pass filters. Instead of these lag elements, special low- and high-pass filters containing higher-order elements may also be used. In addition, it is possible to omit input limiters 230, 260 and output limiter 290, depending on the design.

Low-pass filter 210 determines the static transmission performance of the filter. Likewise, this transmission element essentially determines the response to the driver's selection.

In the case of a change in input quantity QK, a fuel quantity pulse that guarantees acceleration and deceleration of the masses is needed. This fuel quantity pulse is supplied by high-pass filters 240 and 270. The signals of filters 210, 240

5   and/or 270 are phase shifted in time relative to one another by lag elements 220 and 250. This guarantees the chronological sequence of pulses and thus the desired variation of the output signal. Through suitable selection and/or dimensioning of the lag elements, the location of this pulse relative to

10   the time of the change in quantity request and the relative position of pulses may be applied. It is especially advantageous if the lag elements and thus the phase shift are selected so they are variable, depending on the operating state of the engine and/or the vehicle. Suitable parameters

15   for characterizing the operating state include the rpm of the internal combustion engine, the load of the internal combustion engine, the driving speed and/or other parameters.

       High gains of high-pass filters 240 and 270 permit damping of

20   load shock with even a small change in quantity input QK. Input limits 230 and 260 prevent an excessively strong intervention when there are large changes in signal QK.

       According to the present invention, input limiters 230 and 260

25   may be preselected according to quantity request QK. In the case of medium and high loads, the drive train usually rests securely. Changes in quantity request in this range do not usually cause any transition in state between thrust and traction. Therefore, no load shock can occur here either.

30   Input limits 230 and 260 are designed so that damping of load shock is deactivated at these operating points.

       Output limit 290 guarantees that the highest allowed quantity values are not exceeded. Through suitable choice of lag

35   elements, input limiter, the transmission characteristic of the high-pass filters, the low-pass filter and output limiter, the performance of the filter may be optimally adapted to any

desired vehicle.

Figure 3 shows the behavior of the various signals plotted as a function of time. At time T1, the quantity request changes to an increased quantity. At time T3, the quantity request returns to its original level. This is plotted in Subfigure 3a. Subfigure 3b shows the output signal of low-pass filter 210. After time T1, signal QKF0 approaches its new end value according to an exponential function, for example. After time T3, signal QF0 does not return directly, but instead the transition to its original output value takes place only after a certain delay after time T4. This lag between time T3 and time T4 is caused by first lag element 200.

Subfigure 3c shows a diagram of output signal QKF1 of the first high-pass filter. This filter produces a positive pulse at time T1 and a negative pulse at time T3, i.e., the first high-pass filter produces a positive quantity pulse in the transition to increased fuel quantities and a negative quantity pulse in the transition to lower fuel quantities.

Output signal QKF2 of second high-pass filter 270 is plotted in Subfigure 3D. The second high-pass filter produces a negative quantity pulse in the transition to larger quantities and a positive quantity pulse in the transition to smaller quantities. Furthermore, the respective quantity pulse is delayed by lag element 250 by a certain lag time, i.e., the negative pulse does not occur at time T1 but instead occurs at time T2, and the positive quantity pulse does not occur at time T3 but instead at time T4.

In the embodiment illustrated here, a first high-pass filter generates a positive quantity pulse in the transition to larger quantities and a negative quantity pulse in the transition to lower quantities. The second high-pass filter generates an inverse quantity pulse with a time lag. The low-pass filter connected in parallel relays the corresponding

quantity request directly with a given characteristic. Output
signal QKF of filter means 120 as illustrated in Subfigure 3a
is obtained by addition of these three filtered signals.

5   Two corresponding quantity pulses can occur in the transition
to an altered quantity request. In other words, in the
transition to an increased quantity, there is first a positive
quantity pulse and then a negative quantity pulse, and in the
transition to smaller quantities there is first a negative
10   quantity pulse and then a positive quantity pulse. This
guarantees that no load shock will occur.

The procedure according to the present invention is not
limited to the embodiment described here having a low-pass
15   filter and a high-pass filter. In particular, corresponding
digital filters having a suitable performance characteristic
may also be used. It is essential that filtering takes place
so that the filtered signal has at least a corresponding pulse
in the transition to a modified signal. This means that a
20   positive pulse occurs in the transition to an increased value,
and a negative pulse occurs in a transition to a lower value.

The procedure according to the present invention has so far
been illustrated using the example of fuel quantities.
25   However, the procedure according to the present invention may
also be used accordingly for torque signals or other
quantities corresponding to the quantity of fuel.

The quantity request received by the control element can be
30   filtered accordingly. However, the output signal of sensor 140
or another quantity corresponding to the driver's selection
may also be filtered accordingly.